

TO: Andrew Christensen, Chair, Space Science Advisory Committee

FROM: Jonathan I. Lunine, Chair, Solar System Exploration Subcommittee

SUBJECT: Solar System Exploration Subcommittee Meeting

The Solar System Exploration Subcommittee (SSES) of the Space Science Advisory Committee (SScAC) met February 25-26, 2004 at the University of Arizona in Tucson. The purpose of this memorandum is to summarize the findings of that meeting and ask SScAC to consider them and transmit its recommendations to Mr. Orlando Figueroa, Director of the Solar System Exploration.

Presidential Initiative.

The President of the United States has set in motion a new initiative to revitalize human and robotic exploration of the solar system with a near term focus on returning humans to the Moon and a longer term goal involving human exploration of Mars. The rationale for combined robotic and human exploration of the Moon and Mars is consistent with SSED's preexisting themes of understanding the history of the solar system and the evolution of life in it. SSES is very pleased that significant parts of the program will be based on peer-reviewed scientific priorities. SSED will manage a new program of robotic lunar missions as well as an expanded suite of Mars missions. Also, while managing lunar missions following the priorities established by the Office of Exploration, SSED will use its expertise to achieve outstanding new science wherever possible.

SSES welcomes the opportunities afforded by an expanded program of solar system exploration; however, we have some concerns. This expanded program poses challenges to SSED which include providing experienced management and technical teams on short timescales, and interacting effectively with a customer organization, Code T, that is motivated by goals other than science. Some have expressed concern that Initiative priorities may distort ongoing SSED programs such as Discovery or New Frontiers. Furthermore, a mandated freeze on basic R&A programs across SSED interrupts the trend of three years of better-than-inflationary increases, and could adversely impact the scientific results obtained from flight programs.

SSES is extremely pleased that all Solar System Exploration programs are once again unified under the common direction of Orlando Figueroa, a structure we believe makes sense given the nature of the endeavor. Moreover, SSES is happy to hear that SSED is committed to preserving ongoing peer-reviewed programs, such as Discovery and New Frontiers, without impact from Presidential Initiative activities. We recommend that appropriate staffing at all levels below the SSED Director be pursued aggressively, and that experienced engineers and scientists be recruited to create an organization capable of responding to the challenges brought by the new Initiative.

Jupiter Icy Moons Orbiter

We applaud the work of the Jupiter Icy Moons Orbiter (JIMO) Science Definition Team (SDT) in pulling together an excellent set of goals, objectives, and measurements for the icy Galilean satellites in the greater context of the jovian system. The SDT results promise a rich science return from JIMO. We are concerned that the splitting of Prometheus/JIMO between Code S and T, with the science remaining in S, will make it difficult to keep the science priorities for JIMO in the forefront as Code T develops the relevant flight technologies. In particular, requirements of the Exploration Initiative might lead to power and flight technologies that cannot fulfill the JIMO science goals. The SSES recommends establishment of clear and open communication channels between Code S and the new Code T, where the Prometheus project resides, in order to ensure that the science potential of JIMO is fulfilled.

The SSES is strongly concerned about the launch and arrival delays for JIMO. A launch in approximately 2015 and arrival at Europa in approximately 2023 implies a 20 year hiatus in Europa exploration. This gap is particularly troubling because Europa is an extremely high priority target because of its astrobiological potential. The consensus of the committee is that any further delays must be avoided in the mission development.

Discovery

Budget and schedule problems with current Discovery missions (Messenger, Deep Impact, and Dawn) continue to pose a threat to the integrity of the program by 1) forcing a longer interval between opportunities and 2) diluting the emphasis on focused, cost-constrained mission concepts. The SSES applauds the recent progress made by the SSED Director in establishing greater programmatic control over Discovery missions, and creating a dedicated program office at JPL to more carefully track and assess technical progress during mission development. These steps, in conjunction with a continued improvement in communications between scientific and technical/management /cost review panels, will help future selected missions to adhere to the original Discovery Program mandate. The SSES continues to support a strong policy of cancellation for missions that cannot maintain their proposed cost and schedule.

SSES is very pleased that the Discovery program has demonstrated a TMCO-Science review structure that allows exchange of limited but appropriate amounts of information between the two panels by adding a technical member to the science panel. This process permits both panels to understand each other's approaches and concerns while not jeopardizing the principle of independent reviews. SSES recommends that this process be employed in other programs.

New Horizons

The New Horizons (NH) mission will provide the first exploration of the outermost bodies of the solar system, particularly their volatile and organic components, and

addresses two of the four central themes highlighted in the 2003 Planetary Decadal Survey. NH is currently on track for a January 2006 launch, with a mid-2015 encounter with the Pluto-Charon system, followed a few years later by the flyby of a Kuiper Belt Object (KBO). However, recent delays in the fabrication of the radioisotopic power system required for the New Horizons mission may result in inadequate power available near the end of mission, just when the KBO flyby is to occur. This would likely limit mission operations, and so is a concern to SSES, as the Planetary Decadal Survey ranked the KBO flyby as its highest science priority. SSES strongly encourages efforts to protect the current power margins from further erosion.

Also of concern, as with any mission using nuclear materials on a relatively new launch vehicle, are (1) the lengthy launch approval process and (2) the public perception of a launch risk. Given pilot efforts in the community to better educate the public on these issues, SSES encourages NASA to coordinate its own E/PO program with those of non-NASA agency E/PO programs so as to best explain the role of RTGs in outer solar system exploration and how launch risks are analyzed and mitigated.

Mars Exploration

The SSES congratulates JPL, NASA HQ, and the university and industry science and engineering teams of the MER mission for the outstanding success achieved thus far by the Spirit and Opportunity rovers. The Mars Exploration Rover (MER) mission is historically unprecedented. There has never before been a robotic rover—let alone two at any one time-- with extended mobility on a planetary body. The mission goal to provide ground-breaking data bearing on the history of water on Mars has been fulfilled with the announcement of evaporate deposits at Meridiani Planum, and additional profound discoveries are likely to come. The immediate release of images and the depth and accessibility of the website have captured and engaged the public's interest at a level never previously experienced by NASA or any other government agency (over 7 billion hits to NASA and Mars sites since Jan. 3, over 56 million unique visitors). The ready access to exciting mission data through the internet provides a model for future missions.

The SSES recognizes this success would not have been possible without the valuable contribution of the Mars Global Surveyor and Mars Odyssey orbiters in maximizing the scientific and data relay opportunities. This underscores the importance of dedicated communications satellites (such as the planned MTO) to support future Mars exploration missions.

Preventing both forward and backward biological contamination is an essential component of NASA's solar system exploration program. The cost and effectiveness of planetary protection for the Mars Science Laboratory (MSL), including (but not limited to) sterilization to avoid incubation in liquid water melted by the spacecraft from permafrost, is a significant issue. Current cost estimates are very high for planetary protection. Given the astrobiological focus of MSL and its possible high-latitude destination, the SSES considers that resolving these issues is critical. We are pleased that

NASA is aggressively trying to understand and reduce the cost of planetary protection. SSES will monitor this issue closely in coming meetings.

The Next Decade plan prepared by the Mars Science Program Synthesis Group (MSPSG) proposes four “pathways” for Mars exploration, in which the particular sequence of missions would change in response to major discoveries by earlier missions. In its previous meeting, the SSES expressed concern on two issues related to this “pathways” plan, 1) the scope of Mars exploration may become too narrow if limited to one particular “pathway” and (2) there is significant risk that targeted sites (for sample return or a robotic laboratory) may prove to be nonproductive. . The committee will follow this second issue closely in upcoming meetings, as well as the impact of the Presidential Initiative on the pathways concept. In continuing our evaluation of these issues, the committee concludes that the “pathways” plan represents a reasonable approach towards Mars exploration as long as the program does not get locked into a particular pathway. The SSES reiterates its previous recommendation that AOs for future Mars Scout missions should not dictate specific science roles in particular pathways.

Entry probes

Entry Probes are essential for in situ sampling of the deep atmospheres of Venus and the giant planets. There are several cases in which important results from remote sensing were found to be in error once in situ measurements were obtained from entry probes. There is concern in the community that the ability to perform probe missions is at risk of being lost – heat shield materials & testing facilities are no longer available and experts are retiring with no one trained to replace them. We ask that NASA examine the costs associated with production and testing of new heat shield materials, in the context of potential exploration plans involving probes.

Planetary Data System

The committee notes the critical importance of the Planetary Data System (PDS) in preserving the hard-won data from planetary missions and providing access to those data, and the committee welcomes the critical re-examination of PDS structure and processes that is under way. We draw your attention to several specific issues

1. Interface with sample curation facilities – The first samples to be returned to Earth in decades will arrive later this year from *Genesis* and in 2006 from *Stardust*. The issue is that planetary samples require not only curation at specialized facilities but also detailed documentation in order to be usable for scientific analysis. SSES urges PDS to develop interfaces with the NASA sample curation facilities to clarify roles and responsibilities in regard to sample documentation datasets and to enable access to the larger planetary science and external communities.
2. Late deliveries to PDS and budget issues – SSES is aware that some missions fail to meet PDS delivery deadlines for datasets and/or documentation. In some cases, these failures result from conscious choices on the part of mission management responding to schedule and budget pressures, but in other cases

there were evidently factors beyond the control of the mission that led to funding shortfalls for archiving. The Committee is concerned that permanent loss to science from archiving failures may result from relatively minor funding issues.

3. Usability - The PDS nodes are encouraged to develop and engage in E/PO efforts that are consistent with and support the overall OSS E/PO program. It is a concern of the SSES that using PDS products and planetary data within the classroom environment has been difficult for teachers and has diminished usage of these materials. The SSES suggests that new PDS-related EPO proposals endeavor to align with the NASA Education guidelines and goals and that a review board consisting of Code S E/PO specialists and master K-12 teachers be utilized to insure the usability and feasibility of proposed EPO products so they may be validated before they are produced.
4. Peer review – At present, only PDS subjects datasets to an external science peer review process. SSES recognizes that this peer review process is expensive, both for PDS and for the science community, and encourages a reassessment of scope and process. Other communities rely less on peer review by working scientists and more on archiving experts. However, the appropriate balance between review by archivists and peer review may vary from field to field. PDS is aware of this issue and we encourage them to review the current situation, and report back to SSES at a future meeting.

With best regards,



Jonathan I. Lunine
Chair, Solar System Exploration Subcommittee